

SF4

# ***USB Data Logger***



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***Demonstrators:***

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For each student

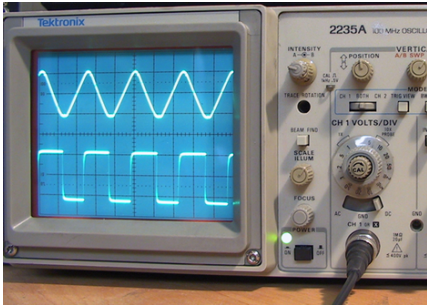
- SF4 handout 1
- SF4 handout 2
- SF4 handout 3 (introductory exercises)

Also available on moodle + additional reading material

develop a modern embedded data logging system

- 1 Hardware** — design analogue circuitry for taking input signal
- 2 Firmware** — control microcontroller unit and handle input
- 3 Communications/Software** — protocol of data transfer over USB to PC, PC user interface
- 4 Product Identity** — datasheet to advertise product, choose how to spend £15 budget
- 5 Experience the dynamics/challenges of research project work**

# SF4 Previous Highlights/Ideas



## Oscilloscope

- Fully featured  
e.g. FFT, Dual Trace



## Radio

- Recording
- Station, volume control
- Autotune



## Healthcare monitors

- Oximeter
- Heart Rate Monitor



## Music Accessories

- Tuner
- Effects amp/pedal



- Recording + playback
- Mixing Desks
- Turntables



## Weather station

- Temperature
- Wind speed
- Humidity

# SF4 *timeline*

10/05	Fri 11-1pm (introduction)
14/05	Tue 9-11am
14/05	Tue 2-4pm
17/05	Fri 11-1pm
21/05	Tue 9-11am ( <b>Interim Report</b> )
21/05	Tue 2-4pm
24/05	Fri 11-1pm ( <b>rep. feedback</b> )
28/05	Tue 9-11am
28/05	Tue 2-4pm
31/05	Fri 11-1pm
04/06	Tue 9-11am
04/06	Tue 2-4pm ( <b>Demonstration</b> )
07/06	Fri, 4pm, submit in <b>final report (moodle)</b>

- ✓ work in pairs (ensure complementary knowledge)
- ✓ timetabled sessions are supported by 1-2 demonstrators, compulsory, attendance sheets are used
- ✓ additional: EIETL access hours:  
8-4pm weekdays  
check PC terminal availability  
(overall time budget ~20h/per week)
- ✓ keep back-ups of computer files/reports

*All dates shifted back 6 days*

# SF4 marking

1

Milestone	When and what happens	What is required
Specification and design – <b>Interim Report</b>	Date: 21 May 2023 by 11am  Report feedback for 10 mins, in pairs, on 24 May  Worth: <b>10 marks</b>	<b>1 set of paperwork per pair</b> containing (2 pages, excl. appendices): analogue circuit design, parts list for purchasing, block diagrams for comms., firmware, software design. Plus: <b>Who's doing which bit?</b>
<b>Demonstration</b>	Date: 4 June 2023 (2-4pm)  Students (in pairs) demonstrate their system with the assessor for 15 minutes  Worth: <b>30 marks</b>	Working hardware; firmware and software (so it can be copied during the demo)
<b>Final Report</b>	Date: 7 June 2023, 4pm (moodle)  Students must <b>individually</b> write up and hand in their report. Each will be assessed on its own merits.  Worth: <b>40 marks</b>	<b>1 marketing datasheet</b> from each student [1 piece of A4 (2-sides) max]  <b>1 independent report</b> from each student (10 sides of A4 max, excluding appendices, as outlined in THIRD YEAR PROJECT GUIDE*; add interim report as appendix).  <b>Signed declaration</b> that student is submitting own work.

2

3

# SF4 *marking*

**Each project will be evaluated based on:**

- ✓ design creativity and functionality
- ✓ 2-way communications between MCU and computer
- ✓ analogue-digital conversion over multiple channels and/or kHz sampling rate (or appropriate alternative)
- ✓ analogue circuitry including appropriate conditioning (eg. anti-aliasing, automatic gain control, DC offset removal etc if appropriate)
- ✓ level of signal processing (eg. Fourier transforms, scaling, averaging etc.)
- ✓ Usability of software interface
- ✓ robust demonstration of whole system

**Clear presentation** and effective communication of system design and its features in the interim and final reports as well as in the datasheet.

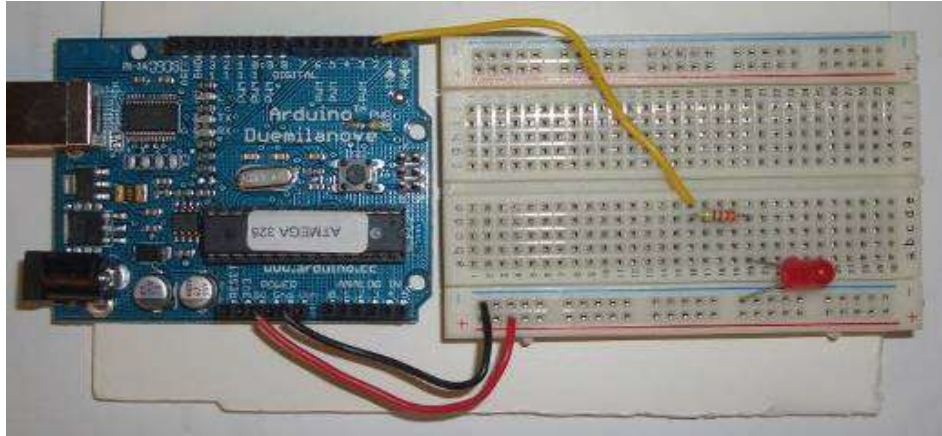
# SF4 *the small print*

- For non-attendance at compulsory timetabled sessions, the penalty is 1 mark per hour or part hour missed.
- For late submission of interim reports, the penalty is 3 marks per day.
- **No reports will be accepted after the submission date for the final report.**  
(computer problems are not acceptable reasons)
- Feedback will be given on each report, but the marks will not be disclosed.
- If work is disrupted by illness, project leader, tutor and Dr Alex White must be notified immediately.
- Max. total length of all reports taken together must not exceed 13 A4 sides, excl. appendices (Interim: 2 pages, Datasheet: 1 page, Final Report: 10 pages)
- Each report requires a signed statement that you are submitting your own work (Note: “No need to reinvent wheel”, BUT you must cite previous work and majority of final report must be your own work)
- **Project moderators will award prizes to top students**



# SF4 *set-up & tools*

Project based around Arduino microcontroller



✓ USB bus powered

✓ Programmed and debugged via USB

The microcontroller board is supplied, additional circuits can be constructed on the breadboard

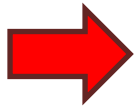
A budget of £15 is provided for purchasing additional components for your circuit (excludes resistors and capacitors from EIETL)

– order from “Onecall” through EIETL technicians, once approved by demonstrators

Go through Introductory Handout

Familiarise yourself with software & components

Familiarise yourself with the arduino board



**Future sessions:** create your own design and implement it.  
Handouts 2 & 3 provide some advice and structure.

## Plan your time carefully

- Components can be ordered before 21st May (Interim report)
- Start firmware/software development before your components arrive
- Fault-finding and debugging might take a lot of the time later on

## Make use of the handouts

## Start simple

- Come up with an achievable concept
- Start by getting a basic system working and then build on that
- Add advanced features later

## Ask demonstrators for help and advice

## Hardware:

- Design your circuit carefully
- Discuss with demonstrators
- Check datasheets thoroughly before ordering components
- Build a neat circuit
- Test each sub-system separately before connecting the next one
- Don't make your entire circuit before testing it
- 5V and 3.3V supplies available from development board (USB bus powered)
- Use the fuses provided
- 20 mA at each I/O pin (> 40mA causes permanent fault) - if you need more current you'll need to provide your own power supply

## Firmware and Software:

- Comment code
- Divide code up sensibly into functions
- Use separate C files as separate modules of code
- Make code readable
- Make small changes and then test them
- Don't write large blocks of code without testing each part
- Use the debugger to see what's going on in the firmware and diagnose problems
- Demonstrators can help you more quickly when code is well written
- Be careful writing firmware in C – as a very low level language it allows you to make mistakes that can be hard to debug
- To install new python libraries on the EIETL machines you need to follow the instruction in your handout (run a code provided on moodle)